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(21) International Application Number: PCT/IB99/01959 (22) International Filing Date: 10 November 1999 (10.11.99) (30) Priority Data: 60/108,243 13 November 1998 (13.11.98) US 09/436,042 9 November 1999 (09.11.99) US (71) Applicant: NOKIA MOBILE PHONES LIMITED [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI). (72) Inventors: MATTILA, Ilpo; Neittyentie 6 as. 5, FIN-92400 Ruukki (FI). KURKINEN, Marko; Irmantie 3 E 14, FIN-90560 Oulu (FI). (74) Agent: HIBBERT, Juliet, Jane, Grace; Nokia IPR Dept., Nokia House, Summit Avenue, Southwood, Farnborough, Hampshire GU14 0NZ (GB).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: METHOD AND APPARATUS TO PROVIDE ROAMING AFTER ACTIVATION WITHOUT OVER THE AIR PROGRAMMING		
(57) Abstract <p>A mobile station (10) has a memory (24) that stores an Intelligent Roaming DataBase (IRDB) that includes a Home Only Enable control bit. The HOE control bit is made to have a factory default (non-activated state) that is enabled, so that prior to activation the mobile station is permitted to camp only on the home system. A home system in this context means a system broadcasting a System Operator Code (SOC) equal to a SOC stored in the mobile station's Number Assignment Module (NAM). Subsequently allowing roaming to non-home systems (i.e., disabling the Home Only Enable control bit in the IRDB) after activation, without Over the Air Programming, can be accomplished by the mobile station automatically disabling the Home Only Enable control bit after Over the Air Activation or some other type of activation.</p>		

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METHOD AND APPARATUS TO PROVIDE ROAMING AFTER
ACTIVATION WITHOUT OVER THE AIR PROGRAMMING

CLAIM OF PRIORITY FROM A COPENDING PROVISIONAL PATENT
APPLICATION:

5 Priority is herewith claimed under 35 U.S.C. §119(e) from
copending Provisional Patent Application 60/108,243, filed
11/13/98, by Ilpo Mattila and Marko Kurkinen. The
disclosure of this Provisional Patent Application is
incorporated by reference herein in its entirety.

10 FIELD OF THE INVENTION:

This invention relates generally to radiotelephones and, in
particular, to radiotelephones or mobile stations such as
those capable of operation with a wireless mobile
communications network.

15 BACKGROUND OF THE INVENTION:

One modern mobile communication system, specifically a
cellular communication system, is referred to as IS-136,
which is described in TIA/EIA IS-136.1, Rev. A, February
1996, and subsequent updated releases. This system employs
20 Digital Control Channels (DCCHs) that enable a mobile
station to gain access to the system. When a mobile station
scans for and subsequently monitors a DCCH, it is said to
be "camped" on that particular DCCH. Page messages and
other information are received from the DCCH.

As currently specified, enabling a Home Only Enable (HOE) control bit in the mobile station provides a fast and convenient activation when using Over the Air Activation (OAA). The mobile station must always be fully Over the Air
5 Programmed (OAP) in order to allow roaming on non-home systems (i.e., the Home Only Enable bit is cleared (disabled) by OAP). However, if the Home Only Enable bit is initially disabled (e.g., set to zero as in conventional practice, thereby enabling roaming to non-home systems) the
10 mobile station may become "stuck" for some period of time onto a non-home system that is not capable of activating the mobile station (if OAA is the activation method to be used). In other words, an unactivated mobile station may roam, for example due to signal fading, to a system that is
15 not capable of activating the mobile station.

OBJECTS AND ADVANTAGES OF THE INVENTION:

It is thus a first object and advantage of this invention to provide an improved method for activating a mobile station.

20 It is a further object and advantage of this invention to provide a method, and a mobile station constructed to operate in accordance with the method, for initially disabling a roaming capability of the mobile station, and to then automatically enable the roaming capability after
25 the mobile station has been activated.

It is another object and advantage of this invention to provide a method, and a mobile station constructed to operate in accordance with the method, for initially causing the mobile station to use only a HOME_SID or
30 HOME_SOC specified in the NAM when searching for service, and to reject all other service providers, and to then, after activation, use the SOC/SID list specified in the

IRDB along with the NAM when searching for service.

It is one further object and advantage of this invention to provide a method, and a mobile station constructed to operate in accordance with the method, for initially
5 providing a Home Only Enable indicator in an enabled condition, and to disable the Home Only Enable indicator after activation.

It is another object and advantage of this invention to remove the uncertainty as to whether the radiotelephone
10 will camp on an eligible or an ineligible system to be Over the Air Activated (OAA), without always requiring to be Over the Air Programmed (OAP), and to also prevent possible delays in activation due to camping on a non-home system.

15 SUMMARY OF THE INVENTION

The foregoing and other problems are overcome and the objects and advantages of the invention are realized by methods and apparatus in accordance with embodiments of this invention, wherein an Intelligent Roaming (IR)
20 procedure is modified to provide an option to configure an Intelligent Roaming DataBase (IRDB) Home Only Enable control bit so that prior to activation the mobile station is permitted to camp only on a home system. A home system in this context means a system broadcasting a System
25 Operator Code (SOC) that is equal to a SOC stored in the mobile station's Number Assignment Module (NAM). Allowing roaming to non-home systems (i.e., disabling the Home Only Enable control bit in the IRDB) after activation, without Over the Air Programming, can be accomplished by the mobile
30 station automatically disabling the Home Only Enable control bit after OAA, or some other type of Activation.

In accordance with an aspect of this invention the IRDB

Home Only Enable control bit is always enabled (e.g., set to '1') when the mobile station leaves the factory. The mobile station subsequently automatically resets (to '0') the Home Only Enable control bit after it has been
5 activated by OAA or by some other means.

BRIEF DESCRIPTION OF THE DRAWINGS

The above set forth and other features of the invention are made more apparent in the ensuing Detailed Description of the Invention when read in conjunction with the attached
10 Drawings, wherein:

Fig. 1 is a block diagram of a mobile station that is constructed and operated in accordance with this invention;

Fig. 2 is an elevational view of the mobile station shown in Fig. 1, and which further illustrates a plurality of
15 cellular and other communication systems to which the mobile station can be bidirectionally coupled through wireless RF links, the systems including a home system and one or more non-home systems;

Fig. 3 is a logic flow diagram of a method in accordance
20 with this invention; and

Fig. 4 depicts a conventional message flow for programming information into an unprogrammed mobile station while on a DTC.

DETAILED DESCRIPTION OF THE INVENTION

25 Reference is first made to Figs. 1 and 2 for illustrating a wireless user terminal or mobile station 10, such as but not limited to a cellular radiotelephone or a personal communicator, that is suitable for practicing this

invention. The mobile station 10 can be a vehicle mounted or a handheld device. The mobile station 10 includes an antenna 12 for transmitting signals to and for receiving signals from a first base site or base station 30. The base station 30 is a part of a first cellular public system comprising a base station/mobile switching center/interworking function (BMI_1) 32 that includes a mobile switching center (MSC) 34. The MSC 34 provides a connection to landline trunks when the mobile station 10 is involved in a call.

Fig. 2 also shows a second BMI_2 32', having associated base station(s) 30' and MSC 32'. By example, the BMI_1 32 may be associated with a first digital public system (e.g., PCS1900 or GSM), and BMI_2 32' may be associated with a second public system, such as the same type or another type of digital system. Both public systems have an associated SID and a SOC. For the purposes of this description it is assumed that the BMI_1 32 is the home system of the mobile station 10, that is, it broadcasts a System Operator Code (SOC) equal to the SOC stored in the mobile station's Number Assignment Module (NAM). The other BMI (BMI_2 32') is assumed to be a non-home system. If the two or more systems are not the same (e.g., both digital TDMA systems that use the same air interface), then the mobile station 10 is assumed to have at least dual mode capability so that it can operate in the different types of systems.

The mobile station 10 of Fig. 1 includes a transceiver comprised of a modulator (MOD) 14A, a tuneable transmitter 14, a tuneable receiver 16, a demodulator (DEMOD) 16A, and a controller 18 that provides signals to and receives signals from the transceiver. These signals include signalling information in accordance with the air interface standard of the applicable cellular system, and also user speech and/or user generated data. As was indicated above,

the transmitter, receiver, modulator and demodulator may be at least dual-mode capable, and may operate with the frequencies, modulation type, access type, etc. of several of the various public and private systems in the environment of the mobile station 10.

It is understood that the controller 18 also includes the circuitry required for implementing the audio and logic functions of the mobile station. By example, the controller 18 may be comprised of a digital signal processor device, a microprocessor device, and various analog to digital converters, digital to analog converters, and other support circuits. The control and signal processing functions of the mobile station are allocated between these devices according to their respective capabilities.

A user interface includes a conventional earphone or speaker 17, a conventional microphone 19, a display 20, and a user input device, typically a keypad 22, all of which are coupled to the controller 18. The keypad 22 includes the conventional numeric (0-9) and related keys (#,*) 22a, and other keys 22b used for operating the mobile station 10. These other keys 22b may include, by example, a SEND key, various menu scrolling and soft keys, and a PWR key. The mobile station 10 also includes a battery 26 for powering the various circuits that are required to operate the mobile station 10.

The mobile station 10 also includes various memories, shown collectively as the memory 24, wherein are stored a plurality of constants and variables that are used by the controller 18 during the operation of the mobile station. For example, the memory 24 stores the values of various system parameters and the number assignment module (NAM). An operating program for controlling the operation of controller 18 is also stored in the memory 24 (typically in

a ROM device). The memory 24 may also store data, including user messages, that is received from the BMI 32 prior to the display of the messages to the user.

For the purposes of this invention it is assumed that some portion 24A of the memory 24, typically the NAM, stores the Mobile Identification Number (MIN), the System Operator Code (SOC), and the above mentioned IRDB. One bit of the IRDB, for example the LSB, is defined as being the Home Only Enable (HOE) control bit. Other bits of the IRDB, which are not germane to an understanding of this invention, can include a Non-Public Priority Enable control bit, a Triggered Scan Disable control bit, Enhanced DCCH History Table (DHT) Enable and DHT Enable control bits, a SOC Disable control bit, and an Alpha Tag Enable control bit. Under conventional practice, the factory default setting (unprogrammed mobile station) for all of these control bits is 'disabled' (set to zero).

The HOME_SOC can be stored in the factory, if known beforehand, or later by a dealer, local provider, or some other entity. It is assumed for the purposes of this invention that the memory 24 stores an indication of some default or home service operator code prior to activation.

In accordance with the teaching of this invention, and referring also to Fig. 3, the factory setting for the HOE control bit is made instead to be enabled (set to one at Step A), thereby initially causing the mobile station 10 to use only a HOME_SID or HOME_SOC that is specified in the NAM when searching for service, and to reject all other service providers (such as the service provider associated with the BMI2 32' of Fig. 2). After activation (Step B), the HOE bit is reset (automatically) to zero (Step C), thereby enabling the mobile station 10 to use a SOC/SID list specified in the IRDB along with the NAM when

searching for service.

In general, the issue of mobile station identification (MSID) management involves the process by which the BMI 32 and a mobile station 10 determine which MSID formats can be used over the air interface. In accordance with the teachings of this invention, after the mobile station 10 has a valid MIN (it has been activated by Over the Air Activation or by other means), the mobile station 10 automatically sets the Home Only Enable bit to zero in order to allow roaming.

Under conventional practice, when the HOE bit is set to zero, the mobile station 10 uses the SOC/SID list specified in the IRDB, along with the NAM, when searching for service, and obtain service from a neutral service provider if no higher priority service providers are found. When the HOE bit is set to a one, the mobile station 10 is defined to only use the HOME_SID or HOME_SOC specified in the NAM when searching for service, and to reject all other service providers.

In accordance with the teaching of this invention, the HOE control bit is set to a one in the mobile station 10 as a default before the mobile station has been activated. After activation the mobile station 10 sets the HOE control bit to a zero in order to allow roaming. The state of the HOE control bit can later be changed again (e.g., can be set to a one) by Over the Air Programming from some service provider.

Fig. 4 depicts prior art message flows that would program information into an unprogrammed mobile station 10 while on a DTC (i.e., a mobile station that has a value of zero for the MIN, the International Mobile Station Identification (IMSI), and the Shared Secret Data (SSD_S, and SSD_C).

In accordance with the teachings of this invention, after the mobile station 10 has a valid MIN (it has been activated by Over the Air Activation or by other means), the mobile station 10 automatically sets the Home Only
5 Enable bit to a zero in order to allow roaming. In this manner the mobile station 10 would be enabled to roam to and obtain service from a non-home system (e.g., the BMI₂ 32' shown in Fig. 2.)

10 It can be appreciated that this technique avoids the problem that was discussed above, wherein an unactivated mobile station could roam to a system that is not capable of activating the mobile station.

Although described in the context of preferred embodiments, it should be realized that a number of modifications to
15 these teachings may occur to one skilled in the art. By example, the teaching of this invention is not limited for use only with systems constructed and operated in accordance with IS-136 or similar air interfaces, or only with digital TDMA cellular systems. Furthermore, the
20 teaching of this invention applies as well to different representations of enabled and disabled features (e.g., more than one bit could be used to provide the HOE indicator, or the bit sense could be inverted (e.g., a logic one indicates a disabled HOE, while a logic zero
25 represents an enabled HOE)).

Thus, while the invention has been particularly shown and described with respect to preferred embodiments thereof, it will be understood by those skilled in the art that changes
30 in form and details may be made therein without departing from the scope and spirit of the invention.

CLAIMS

What is claimed is:

1. A method for operating a mobile station, comprising steps of:

providing an unactivated mobile station such that the mobile station is capable of obtaining service only from a service provider having a service provider code that is stored in the mobile station as a home service provider;

activating the mobile station; and

in response to activating the mobile station, automatically enabling the mobile station to obtain service from other service providers.

2. A method for operating a mobile station, comprising steps of:

providing a mobile station with a factory default bit setting that prevents the mobile station from obtaining service from a service provider that is not a home service provider;

activating the mobile station to provide the mobile station with a mobile identification number; and

in response to activating the mobile station, automatically changing the factory default bit setting for enabling the mobile station to roam to and obtain service from a non-home service provider.

3. A method for operating a mobile station, comprising steps of:

providing a mobile station with an Intelligent Roaming Data Base (IRDB) having a Home Only Enable (HOE) control bit factory default setting that is enabled;

activating the mobile station; and

in response to activating the mobile station, automatically disabling the HOE control bit.

4. A mobile station, comprising:

a transceiver;

a controller; and

a memory coupled to said controller, said memory storing an Intelligent Roaming Data Base (IRDB) having a Home Only Enable (HOE) control bit factory default setting that is enabled.

5. A mobile station as in claim 4, wherein said controller is responsive to said mobile station receiving activation data for automatically disabling said HOE control bit.

6. A mobile station as in claim 4, wherein said controller is responsive to said mobile station receiving activation data, through said transceiver, for automatically disabling said HOE control bit.

7. A mobile station as in claim 5, wherein said controller is responsive to said mobile station receiving over the air programming data, through said transceiver,

for again placing said HOE control bit into the enabled setting.

DRAWINGS, MISSING UPON FILING

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 99/01959

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04Q7/38 H04Q7/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	TAYLOR A: "OVER-THE-AIR SERVICE PROVISIONING" ANNUAL REVIEW OF COMMUNICATIONS, 1 January 1998 (1998-01-01), pages 953-959, XP000793196 page 955, left-hand column, line 15 - line 22 page 955, left-hand column, line 31 -page 956, left-hand column, line 6	1-4
A	WO 97 14258 A (QUALCOMM INC) 17 April 1997 (1997-04-17) page 7, line 35 -page 13, line 23 -/-	1-4

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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